IB MYP YEAR 5

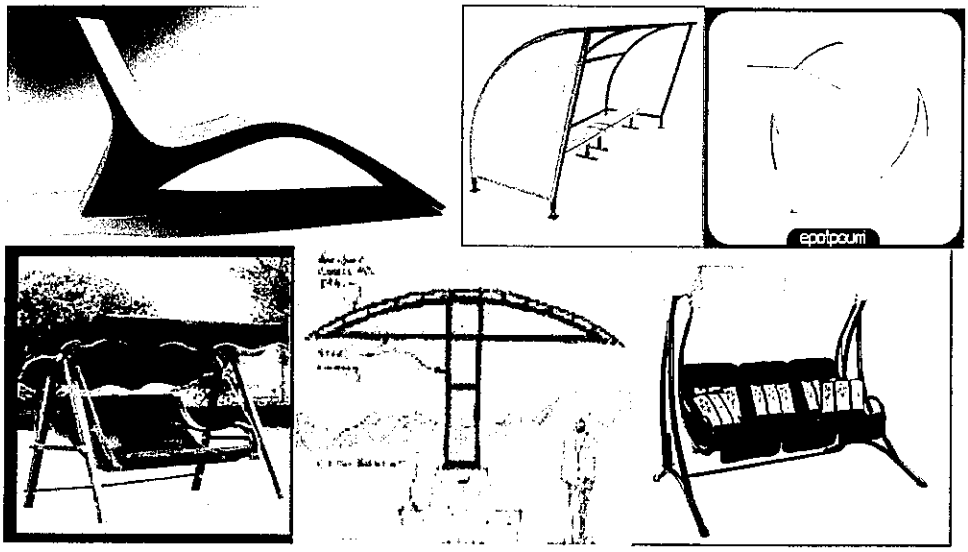
ASSESSMENT TASK

The water front bench

Subject:	Y10 Standard Mathematics	**Name (Class):**	Andrew Lau (10) Hope
Topic:	Polynomials	**Reading material:**	Chapter 2 & 6 in Book A
Date of task assigned:	22nd September, 2011	**Due Date:**	6th October, 2011
Submission of task:	Please submit a print copy of the assessment to your Maths teacher on or before Thursday, 6th October 2011 at 0840.		

This task assesses Criteria A, C, & D.

Task Brief: Design a water front bench with a canopy.



ADVICE:
Read the criteria descriptors and task-specific rubrics carefully before you start your work. This will give you a clear understanding of what is required and what a high quality piece of work for this task must include.
This way you give yourself the best chance of achieving the highest levels in this task.

Please attach this sheet to your final report.

A 8
C 6
D 8 5

The Task

Background

You have been hired as a new designer at the *Polynomial Seating Company (PSC)*. The company is world famous for designing and manufacturing creative and attractive seats and benches, mainly for outdoor use. The Manager is giving you a special task for a new client.

You are given the task of designing a chair/bench for use outdoors. The client wants your designs quite quickly. So does the manufacturing department of PSC, as they will want to start production quite soon.

The bench should be (a) comfortable, (b) suitable for keeping off the sun and the rain and (c) have a profile that is highly mathematical in shape – in fact it should use functions that you have met in this topic of Polynomials (i.e. quadratics).

Of course, you won't ***build*** the bench, but you will come up with the functions (equations) that will define the shape of the bench.

You will submit a report that outlines the development of your design. The report will be assessed using MYP Assessment Criteria A, C and D, and the paragraphs below expand on this.

Criterion A:

Here you show your ***knowledge and understanding*** of quadratic equations and their graphs. You MUST provide all the appropriate information about your design specification including:

- Accurate plots of all graphs, showing the important features of the design;
- Sets of equations describing all curves used and listing the range of x-values;
- The process (mathematics) by which you came up with the equations used in the design including possible modifications that could be made if requested by the client.

In order to score top marks in this criterion, you should show how you have used your knowledge in ***unfamiliar situations*** by embedding and developing at least one function that has not been covered in class, such as a cubic.

Criterion C:

Your design needs to be ***communicated*** effectively for your manager, the client, and the manufacturing department who will use it to make the actual bench. This means that all graphs will be clearly labeled, and all appropriate diagrams and charts will be explained. Equations will have to connect sensibly to appropriate units of distance.
Any software used will have to be cited and, if necessary, explained.

Criterion D:

Before you begin your design, it is important that you come up with a set of specifications so the client can see how comfortable, sheltered, and creative your design will be. You need to ***reflect*** (and possibly research) on associated real-life issues, such as:

- People's sizes and comfort levels;
- How people sit or lounge;
- How the sun and the rain act;
- How easily the bench might be stored away;
- Any other features that you believe may be relevant to the product.

Once you have finished your design, please ***evaluate*** it against the specifications you listed before you began. Consider how well your model fits your specifications by checking the degree of accuracy (possibly percentage error or sig. fig.). Because the client wants the initial design in just a few days, there may well be a number of things you cannot do. If you had more time, suggest what other things you might do to improve your product? What different mathematical methods might you have tried?

Assessment Criteria for Y10 Standard Maths Bench Assessment

Criterion A

Levels	Task-Specific Rubric	Official IB Descriptors
0	The student does not reach a standard described by any of the descriptors given below.	
1-2	The student generally makes appropriate selections of one or more simple functions (such as y=mx+b, $y = x^2$) and manipulates them in to form a chair/bench.	The student **generally** makes appropriate deductions when solving **simple** problems in **familiar** contexts.
3-4	The student generally makes appropriate selections of two or more non-linear functions (eg quadratics) and manipulates them to form a chair/bench.	The student generally makes appropriate deductions when solving **more complex** problems in **familiar** contexts.
5-6	The student generally makes appropriate and accurate selections of three or more functions (eg a mixture of linear and quadratic) and manipulates them to form a chair/bench with a canopy.	The student **generally** makes appropriate deductions when solving **challenging** problems in a **variety** of **familiar** contexts.
7-8	The student consistently makes appropriate and accurate selections of four or more functions, at least one of which is an unfamiliar one (eg cubics, exponential etc) to form a chair/bench with a canopy.	The student **consistently** makes appropriate deductions when solving **challenging** problems in a **variety** of contexts including **unfamiliar situations.**

Criterion C

Levels	Task-Specific Rubric	Official IB Descriptors
0	The student does not reach a standard described by any of the descriptors given below.	
1-2	Some very basic equations are offered and described. There are some appropriate diagrams and graphs. There is a basic narrative that describes the processes used.	The student shows **basic use** of mathematical language and/or forms of mathematical representation. The lines of reasoning are **difficult to follow.**
3-4	Equations used are generally clearly explained. Clear, accurate and relevant graphs, and/or charts and tables are provided. It is generally easy to see how these diagrams describe the development of the chair/bench design. Key vocabulary is used. Narrative is generally accurate.	The student shows **sufficient use** of mathematical language and forms of mathematical representation. The lines of reasoning are **clear though not always logical or complete.** The student moves between different forms of representation with **some success.**
5-6	Several graphs and diagrams are offered to show the development of the chair/bench. Graphs are accurate and detailed. Equations are provided which match the important features of the graphs. It would be possible for PSC engineers to produce the chair/bench from the diagrams. The narrative is very clear.	The student shows **good** use of mathematical language **and** forms of mathematical representation. The lines of reasoning are **concise, logical** and **complete.** The student moves **effectively** between different forms of representation.

Criterion D

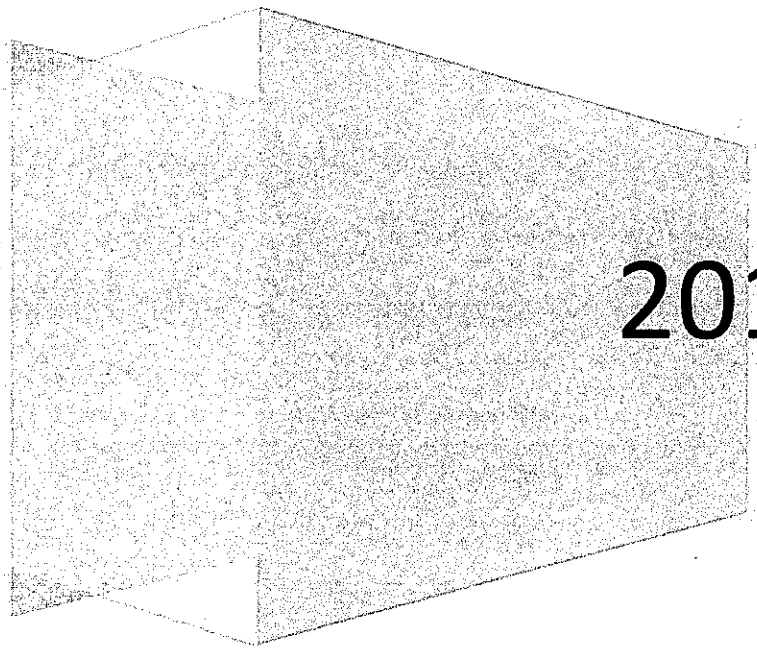
Levels	Task-Specific Rubric	Official IB Descriptors
0	The student does not reach a standard described by any of the descriptors given below.	
1-2	There has been a limited amount of relevant research undertaken. To some degree, the student has connected this research to the design of the chair/bench.	The student **attempts** to explain whether his/her results make sense in the context of the problem. The student **attempts to describe** the importance of his or her findings in connection to real life where appropriate.
3-4	The student has undertaken good, relevant research and has used this in the development of the chair/bench. The student has explained with justification how the design features of the chair/bench relate to real-life issues. The student tries to explain the accuracy of the equations.	The student **correctly but briefly explains** whether his/her results make sense in the context of the problem. The student **describes the importance of** his/her findings in connection to real life where appropriate. The student **attempts to justify** the degree of accuracy of his/her results where appropriate.
5-6	The student critically compares the final product with features identified at the design stage. Real-life issues associated with the design are developed. The student justifies appropriateness and accuracy of all equations and offers a critical review of the mathematical methods used, suggesting viable alternatives or improvements where appropriate.	The student **critically explains** whether his or her results make sense in the context of the problem. The student provides a **detailed explanation** of the importance of his/her findings in connection to real life where appropriate. The student **justifies** the degree of accuracy of his/her results where appropriate. The student suggests improvements to his/her method when necessary.

Victoria Shanghai Academy

Water Front Bench Desgin

Math Assessment

Andrew Lau- Y10 Hope



2011-2012

Math Assessment~ Chair Design

Surveys[1]

In order to understand what the end users want, a survey is conducted to collect opinion from them.

1. How long do you want the bench be? Create Chart Download

	Response Percent	Response Count
Suitable for 1 Person	20.0%	2
Suitable for 2 People	50.0%	5
Suitable for 3 People	20.0%	2
Suitable for 3+ People	10.0%	1
answered question		10
skipped question		0

2. What material do you want the bench be made with? Create Chart Download

	Response Percent	Response Count
Plastic	40.0%	4
Wood	40.0%	4
Wool	10.0%	1
Glass	10.0%	1
answered question		10
skipped question		0

3. Do you want the bench have a television set on the bench? Create Chart Download

	Response Percent	Response Count
Yes	20.0%	2
No	80.0%	8
answered question		10
skipped question		0

[1] *Survey Monkey*. Computer software. *Survey Monkey*. Web. 29 Sept. 2011. <www.surveymonkey.com>.

4. Do you want a leg rest on the bench?

Create Chart | Download

	Response Percent	Response Count
Yes	80.0%	8
No	20.0%	2
answered question		10
skipped question		0

5. What angle do you want the back of the bench be?

Create Chart | Download

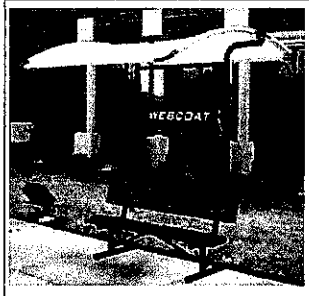
	Response Percent	Response Count
90 degree	10.0%	1
100 degree	0.0%	0
110 degree	20.0%	2
120 degree	50.0%	5
130 degree	20.0%	2
140 degree	0.0%	0
150 degree	0.0%	0
160 degree	0.0%	0

Location of the bench[2]

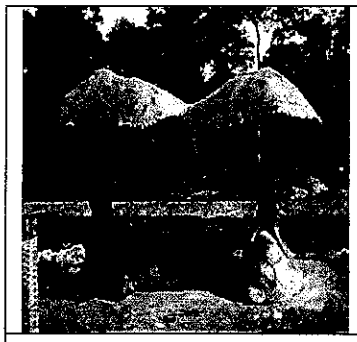
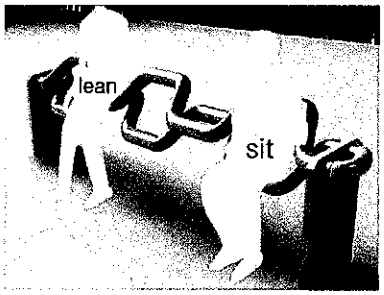
It would be un-realistic for this bench to be designed for Hong Kong, since in Hong Kong no one really gets out of their home, and tend to spend the most possible time in door. So, this bench is going to be designed for Canada, because the people in Canada love outdoor, and they seem to have more time to relax outdoor.

Climate of Canada:
Canada's climate varies in different seasons, it is mostly sunshine, from my experience, it rains about one time per two months, so obviously it is mostly sunshine.

Bench Design Analysis

	*Type of Bench:* Regular park bench *Advantages:* • easy to make • low manufacturing cost *Disadvantage:* • Uncomfortable design • Stripes might hurt back and bottom *Conclusion:* A bad design, not comfortable and cannot prevent the sun and ran.
	*Type of Bench:* Regular bench with shade *Advantages:* Prevents the sun and rain *Disadvantage:* • Uncomfortable bench • Too small shade *Conclusion:* this design of the chair has a shade to prevent the sun and rain, but the shade is too small for real use, moreover, the chair is one of the most uncomfortable chair ever made, it's just some metal strips.

[2] "Banff Canada - Banff National Park - Ski in Banff." *Online Travel Guides of Travel Destinations - Las Vegas, Caribbean, Hawaii and Machu Picchu.* Web. 3 Oct. 2011. <http://www.destination360.com/north-america/canada/banff>.

	*Advantages:* • Has a shade to prevent the sun and rain • Extremely creative *Disadvantage:* • Small shade • Might not be comfortable *Conclusion:* this chair is very creative but not practical
	*Type of Bench:* Bar Bench *Advantages:* • Save space • Clean *Disadvantage:* • Uncomfortable design • bars might hurt back and bottom *Conclusion:* a innovative design to save space and creative, only problem being is that it will be uncomfortable when sitting for a long period of time.

Material Research

This part of the research is going to focus on the benefits of the material for the bench design. It's not going to focus too much on the history of it since it is not too related to the project. The surveys had concluded that the first two most popular materials for their benches are plastic and wool, so this research is only going to focus on it but in depth.

Wool[3]

Wool had been used by humans for centuries; it provides warmth and comfort in all weathers.

Benefits of Wool[4]

Comfort

It is suitable in different weathers-

Wool is suitable in different seasons, in winter, it provides people with warmth, in summer, and it provides people with comfort.

[3] "The Advantages of Wool." *Wool Store Insulation WA*. Web. 2 Oct. 2011. <http://www.wsi.com.au/advantages/>.

[4] Ma, Lanh. "The Advantages of Wool Fabric | EHow.com." *EHow | How to Videos, Articles & More - Trusted Advice for the Curious Life | EHow.com*. Web. 3 Oct. 2011. <http://www.ehow.com/about_6397773_advantages-wool-fabric.html>.

Safety

It is flame resistance

This bench chair is going to be designed for outdoor use, probably in the beach or something. So it is crucial that it is a safe material since it is not indoor, and bad people might set a fire to it.

Environmental Benefits of Wool

Animal Friendly

No animal is killed

During the process of extracting wool, no animal is killed, instead, the wool is shaved out of the sheep, which the wool will naturally come back, so it does not have negative effect on the sheep.

Biodegradable

It automatically vanishes

After the product is discarded, it will automatically vanish after a long period of time, and it can also be used for recycling, therefore, it doesn't cause harm to the environment.

Long Lasting

Wool can last up to 20 years, very good value for money

Wool products can last up to 20 years, and it can be used for a really long time, therefore it is really good value for the money.

Plastic[5]

Plastic

Plastic is largely used in the manufacturing process of industrial products. Plastic are polymers that have a high molecular mass. It can be fond a lot in our daily life, such as plastic bottled water, plastic cups and plates etc. Moreover, substances can be also added to the plastic itself, to increase improve the plastic for stronger usage, or to reduce cost. Plastic usually have relatively low cost, and it is easy to manufactured, therefore, a large amount of products uses it. [4]

The first made man plastic was created by Alexander Parkes. The material used in that time was called Parkesine, and it was an organic material that is made from cellulose, and it could be molded once heated, and after it cool down, it will stay in that shape. [5]

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[5] "The History of Plastic." *Inventors*. Web. 1 Oct. 2011. <http://inventors.about.com/od/pstartinventions/a/plastics.htm>.

Different types of plastic [6]

Symbol	Name	Where is it used??
 PETE	POLYETHYENE TEREPHTHALAT (PET)	• Mineral water bottles • Soda Bottles • Squash bottles • Salad Dressing Bottles
 HDPE	HIGH DENSITY POLYETHEYLENE (HDPE)	• Milk Bottle • Shampoo Bottles • Detergent Bottles • Juice Bottles
 V	POLYVINYL CHLORIDE (PVC)	• Food Trays • Oil Bottles • Toys • Shower Curtains
 LDPE	LOW DENSITY POLYETHYLENE (LDPE)	• Garbage Bags • Plastic wrap • Toothpaste bottles
 PP	POLYPROPYLEN (PP)	• Meal Trays • Margarine Tubs • Straws
 PS	POLYSTYRENE (PS)	• Yogurt Containers • Ice Cream Containers

Plastic Recycling

Recycling plastic is very important these days, because a large amount is being used each day, more than 28.3 gallons of plastic bottles were disposed each year. [8] According to research, people in the United States throw away 2.5 million plastic bottles per hour, and it is one of the most thrown away stuff in the America. As there are different important events going on the earth such as global warming, people really need to start recycling, producing new plastic needs a significant amount of fossil fuel, which contribute to global warming etc. Moreover, plastic takes a long time to degrade, and probably more than a hundred year to degrade, therefore, it is better to recycle than degrade.

What is plastic recycling?

Plastic recycling is the process of processing scrap and waste plastic into new plastic materials. [9]

Benefit of Recycling Plasitc

The benefit of recycling plastic is that is uses a significant less amount of energy to recycle plastic than to reproduce new plastic, according to information, it uses 20-40 percent less energy than manufacturing new plastic. Additionally, when producing plastic, it combine petroleum and

[6] "The Benefits of Plastic and Polymers in Our Society." *Plastics Industry: Classifying Plastics - Jobs and Employment - History of Plastic.* Web. 3 Oct. 2011. <http://www.plasticsindustry.com/plastics-benefits.asp>.

natural gas with oxygen, and importantly is requires to burn up a large amount of oil. And because of that, when recycling plastic, it reduces a lot of oil consumption, and additionally, it saves a lot of the landfill space, as plastic uses a lot of landfill spaces. Additional benefit of plastics is that recycled plastic can be made into plastic lumber, which is more durable than newly produced plastic. At last, recycling plastic is benefiting the environment; recycling plastic can reduce greenhouses gas emissions. [9]

What kind of Plastic can be recycled?

As plastic is divided into different categories, some kind of plastic may be recycled while some may not. We can distinguish which kind of plastic may be recycled by looking at the bottom of bottles and containers, where it has a triangle that tells us the type of plastic that it is. With this triangle, it generally  means that it can be recycled, and most plastic contains this logo on the bottom of the bottle and container, therefore, most types of containers and bottles may be recycled. [7]

Environmental Issues on Plastic

Plastic is one of the major toxic pollutants now days. It is a non-biodegradable substance, and plastic pollutes the earth air and water. Plastic damages the environment both during the production process and disposal. Other than damaging the environment, research also shows that it cause cancer to humans. Also, when recycling plastic, it sometimes crates skin and respiratory problems. [11] Importantly is the chemical that it produces. Chemicals are added to plastic in the creation process, and the chemical are absorbed by human body, which may harm human health and may also injure and poison wild life. [12]

Conclusion

Both of the materials have it pros and cons, and in order to make the best use of the materials, both of the materials should be used for different purpose. Since plastic is water resistance and transparent, it will be used for the chair itself and the shade for prevent rain from wetting the inside. Wool isn't water resistance and therefore it is going to be used for the cushions, and also as a curtain under the plastic shade to cover the sunshine if the user doesn't like it. Plastic is very **environmental friendly and also safe** for use, so it is going to be used for most of this design.

People's Sizes and Comfort

Information was collected in order to look at people's sizes and to design the most comfortable chair possible for them. The results are below.

Person	Ankle to feet	Stomach to ankle	Shoulder to Arm	Arm to Hands		Back	Shoulder
1	50	103	30	48	54	50	45
2	46	103	31	44	50	48	41
3	49	94	35	24	45	47	40
4	31	96	28	38	48	48	38
5	32	108	30	45	58	50	40
6	55	97	30	25	51	46	42
7	47	85	17	26	54	31	42
8	45	88	26	24	48	42	40
9	77	110	30	40	50	57	50
10	40	40	30	30	40	40	40
11	43	93	31	44	56	49	46
12	43	98	27	25	48	50	37
13	40	102	28	25	51	51	44
Average	46	93.61538462	28.69230769	33.69230769	50.23076923	46.84615385	41.92307692

According to the results from the interview, the measurements are going to be according to it.

Seat and leg rest: This part of the bench is going to be calculated from the bottom to the foot. Keeping in mind that the person using the chair won't be sitting straight the whole time, and might lie down, the measurements of this part of the bench is going to be the total height of a person, which is 180cm.

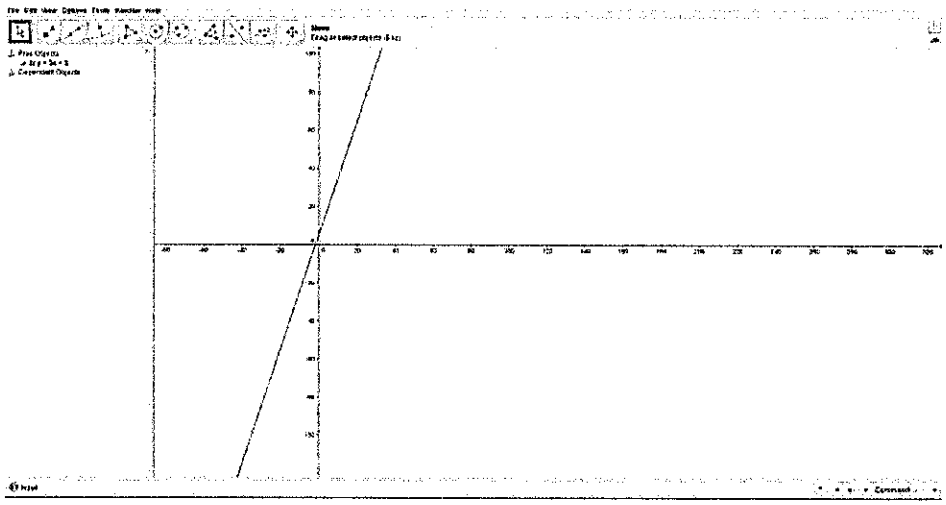
Back of the Seat: The back of the seat is going to be the height of the person's back, although the average height of a person's back is 46, the back is going to be **60cm** since there is going to be a headrest installed on the seat, so having 14cm wider will make sure that everyone is going to be comfortable.

Canopy: The canopy is going to be covered from the back of the seat to the end of the seat, to promise that not a single drop of water is going to be leaked into the bench area, the canopy will be **260cm** long in total, and it won't compromise the comfort of the chair, since the canopy is constructed of transparent plastic, it will allow sunlight into the bench while keeping the rain out.

Equations

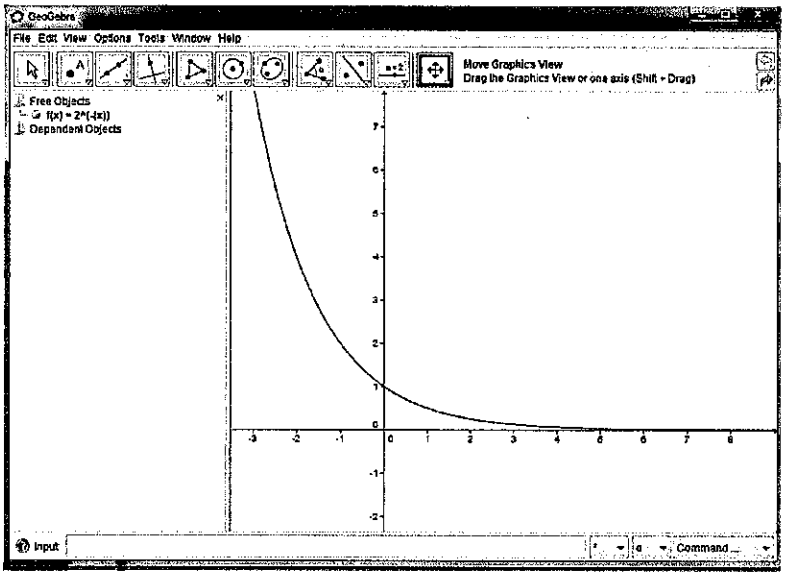
1. Y=mx+c
   Y=3.2x+2, -10, -12

For the stand of the canopy: the stand of the canopy is going to be at an angled shape, to minimize the noise of the wind, and to allow the rain to leave the canopy.



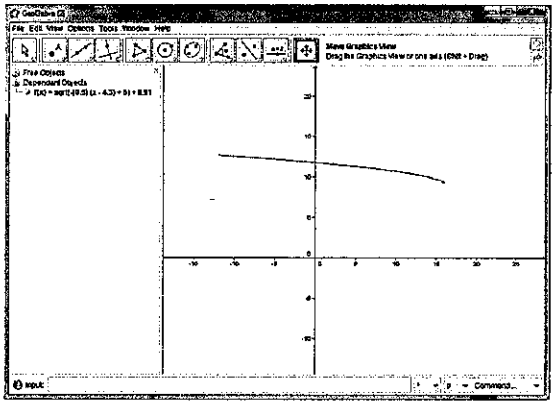
2. y = 2 ^ (-x) x=-10,0

For the back of the chair: The back of the chair is going to be curved, in order to allow the person inside the bench to have more comfort.



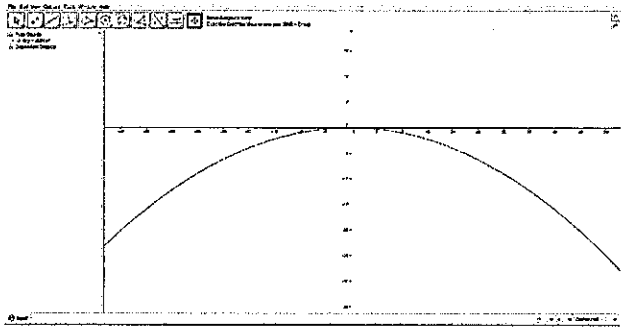
3. Y=-0.5^2(x-4.3)+6+8.91,-12,16

Canopy: the canopy is going to be angled and curved in the front. It is angled to prevent the rain from staying on top of the canopy, which may overweight and break it. The curve at the front is designed to prevent side winds and also rain from the side, to protect the people inside the bench.



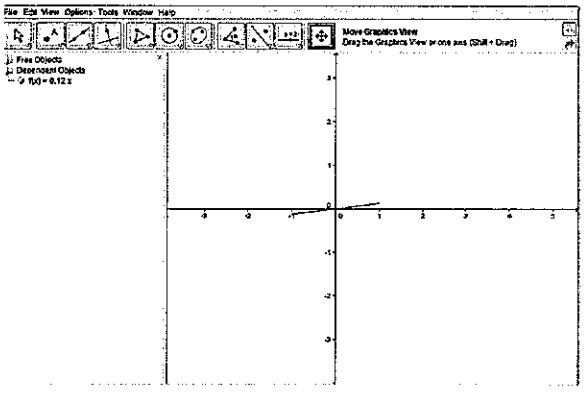
4. Y=0.01x^2,-16,16

Bottom part of the bench: the bottom part of the bench is again going to be curved, which provide people inside in the bench with a sense of security, and also to **improve the blood circulation**, also curve is the most comfortable way for people to rest.



5. Y=0.1x,-8,-6

This is going to be the equation for the hand rest of the chair, it is designed in curve to provide the optimum comfort and increase the **blood circulation.**



Design Specification

- The bench is going to have three seats

  *This bench is going to be designed for Canada, which is very **family orientated**, so having three seats for a family is most suitable.*

- The bench is going to be mainly constructed of plastic

  *This waterfront bench is going to be used in outdoors. After continuous research, plastic is the most suitable material to construct it because it is **windproof, waterproof, easy to clean and safe.***

- The seat of the bench is going to be constructed of wool

  Comfort is very important for the bench design, and wool is a very comfortable material. The inside of the bench is going to b covered with the canopy, so there won't be worries for the bench getting wet.

- The seat is going to be curved

  Curved is the most comfortable line for people to relax, it gives people a sense of security than straight line. More importantly, it improves blood circulation which will make the people inside the bench to be healthier.

- The bottom of the seat is going to be curved

  Again, the curved design of the bottom of the seat and bottom provides people with a sense of security to relax and do whatever they want.

- There is a plastic canopy

  The material of the canopy must be waterproof so that it doesn't soak the person under the canopy.

- The seat is angle adjustable

  The bench is multifunction, people can read in it, which they might prefer a 120 angle, and might work in it which might prefer a 90 angle. So the bench should be able to adjust into different angles to provide the ultimate comfort.

- There is a piece of dark wool under the plastic canopy that can be pulled over to cover the plastic

  The canopy of the bench is going to be constructed of ***transparent plastic****, to* ***allow sunlight into the bench and also allow view of the beautiful sky,*** *but importantly, some people doesn't like the sun as much as other do, so having* ***a curtain under the canopy will allow those people who doesn't like the sun to enjoy the bench too.***

- The end of the canopy is going to be curved to prevent rain from the side

  The rain doesn't always fall down from the sky in a straight line, sometimes the wind will blow the rain in from sideways, so having a curved canopy can prevent the rain from sideways.

- There is going to be waterproof storage area

  Storage is very important for the bench because it is where people want to relax for a long time, so storing their ***ipads, iphones, ipod, macbooks into the storage area is crucial.*** *More importantly,* ***it should be waterproof, since there might be floods and we don't want those expensive electronics to be ruined.***

- The stand of the canopy is going to be angled to minimize wind noise

  Scientific researches proved that curved surface allows the wind to blow through but not hitting it directly, so a curved surface for the stand will allow the people inside the chair to have least noise heard, therefore provide comfort.

Possible Modifications for Client

The client is our boss, so no matter whatever the client request it should be met. The follow is the design specification divided into *essential criteria* and *modifiable criteria.* All the design specifications are going to be divided into these two parts, the essential criteria cannot be changed due to manufacturing restrictions.

Essential Criteria	Modifiable Criteria
The bench is going to have three seats	The seat of the bench is going to be constructed of wool
The bottom of the seat is going to be curved	The bench is going to be mainly constructed of plastic
The seat is going to be curved	The seat of the bench is going to be made of wool
There is a plastic canopy	The seat is angle adjustable
There is a piece of dark wool under the plastic canopy that can be pulled over to cover the plastic	
The end of the canopy is going to be curved to prevent rain from the side	
There is going to be waterproof storage area	
The stand of the canopy is going to be angled to minimize wind noise	

Final Words on modifications: This design has been done after weeks of intensive market research conducted on the end users and the county, please respect the designer's idea and don't make too much modification to the design. *The designer has the right to deny any of the modification.*